

COTTON REGION REPORTS.

In the following table are given the means of the maximum and minimum temperatures and the average rainfall for the cotton districts during the month of August. For the purpose of comparison, the averages for these districts during the four preceding years are also given. The rainfall, as compared with the averages of four years, is excessive in the districts of Wilmington, Memphis, Montgomery, Augusta, and Mobile; it is about normal in the districts of Atlanta and Galveston; in the other districts it is deficient. The mean of the minimum temperatures is above the average in all districts; the mean of the maximum temperature shows only slight departures from the normal.

Temperature and rainfall data for the cotton districts, August.

Districts.	Rainfall.			Temperature.								Extremes for Aug., 1886.	
				Maximum.				Minimum.					
	Average for August of four preceding years.	Average for August, 1886.	Departures.	Mean for Aug. of four pre- ceding years.	Mean for Aug., 1886.	Departures.	Mean for Aug. of four pre- ceding years.	Mean for Aug., 1886.	Departures.	Max.	Min.		
	Inch.	Inch.	Inch.	°	°	°	°	°	°	°	°		
New Orleans.....	4.15	2.69	-1.46	91.1	92.7	+ 1.6	71.2	71.4	+ 0.2	102	50		
Savannah.....	5.74	5.24	- 0.50	90.8	90.7	- 0.1	71.3	72.4	+ 1.1	106	60		
Charleston.....	7.30	4.16	- 3.14	89.6	88.8	- 0.8	69.0	69.5	+ 0.5	100	43		
Atlanta.....	4.60	4.52	- 0.08	87.9	88.4	+ 0.5	67.4	68.9	+ 1.5	100	57		
Wilmington.....	4.25	7.42	+ 3.17	88.2	87.4	- 0.8	67.3	68.7	+ 1.4	100	55		
Memphis.....	2.64	3.89	+ 1.25	88.6	89.2	+ 0.6	65.0	68.2	+ 3.2	102	44		
Galveston.....	2.32	2.59	+ 0.27	94.0	95.0	+ 1.0	70.5	73.1	+ 2.6	108	55		
Vicksburg.....	3.13	2.32	- 0.81	90.8	92.4	+ 1.6	69.1	71.6	+ 2.5	100	61		
Montgomery.....	3.34	4.57	+ 1.23	90.4	90.2	- 0.2	68.2	69.7	+ 1.5	104	52		
Augusta.....	3.81	4.52	+ 0.71	90.2	88.9	- 1.3	67.9	69.3	+ 1.4	101	58		
Little Rock.....	2.45	2.05	- 0.40	90.7	92.7	+ 2.0	65.7	68.9	+ 3.2	111	49		
Mobile.....	2.95	3.44	+ 0.49	92.2	91.2	- 1.0	69.4	70.3	+ 0.9	104	60		

NAVIGATION.

STAGE OF WATER IN RIVERS.

In the following table are shown the danger-points at the various river stations; the highest and lowest depths for August, 1886, with the dates of occurrence, and the monthly ranges:

Heights of rivers above low-water mark, August, 1886.

[Expressed in feet and tenths.]

Stations.	Danger-point on gauge.	Highest water.		Lowest water.		Monthly range.
		Date.	Height.	Date.	Height.	
<i>Red River:</i>						
Shreveport, Louisiana.....	29.9	17, 18	3.3	11, 12	-0.8	4.1
<i>Arkansas River:</i>						
Fort Smith, Arkansas.....	22.0	9	13.7	31	2.7	11.0
Little Rock, Arkansas.....	23.0					
<i>Missouri River:</i>						
Yankton, Dakota.....	24.0	5, 6	20.1	29, 30, 31	18.1	2.0
Omaha, Nebraska.....	18.0	11, 12, 13	9.2	31	8.0	1.2
Leavenworth, Kansas.....	20.0	11	9.8	30, 31	7.0	2.8
<i>Mississippi River:</i>						
Saint Paul, Minnesota.....	14.5	2, 23	2.5	15	1.2	1.3
La Crosse, Wisconsin.....	24.0	27	4.6	14, 15, 18, 19	2.3	2.3
Dubuque, Iowa.....	16.0	31	4.6	16, 17, 18, 21, 22, 23	2.0	2.6
Davenport, Iowa.....	15.0	31	2.4	17 to 27	1.0	1.4
Keokuk, Iowa.....	14.0	14	2.6	21, 22, 23, 26, 27	1.0	1.6
<i>Saint Louis, Missouri:</i>						
Saint Louis, Missouri.....	32.0	18	9.3	31	6.3	3.0
Cairo, Illinois.....	40.0	11	11.8	22	9.4	2.4
Memphis, Tennessee.....	34.0	2	10.0	23, 24	7.8	2.2
Vicksburg, Mississippi.....	41.0	1	13.5	28	7.9	5.6
New Orleans, Louisiana.....	13.0	1	4.8	16, 31	3.2	1.6
<i>Ohio River:</i>						
Pittsburg, Pennsylvania.....	22.0	18	7.7	30	0.3	7.4
Cincinnati, Ohio.....	50.0	24	13.7	31	7.0	6.7
Louisville, Kentucky.....	25.0	19	7.3	17	4.5	2.8
<i>Cumberland River:</i>						
Nashville, Tennessee.....	40.0	7	10.9	1	2.7	8.2
<i>Tennessee River:</i>						
Chattanooga, Tennessee.....	33.0	8	7.1	30, 31	3.5	3.6
<i>Monongahela River:</i>						
Pittsburg, Pennsylvania.....	29.0	18	7.7	30	0.3	7.4
<i>Savannah River:</i>						
Augusta, Georgia.....	32.0	20	11.4	24	7.1	4.3
<i>Mobile River:</i>						
Mobile, Alabama.....		28	18.4	7	16.7	1.7
<i>Sacramento River:</i>						
Red Bluff, California.....		1 to 10	2.0	31	0.6	1.4
Sacramento, California.....		1	10.0	27 to 30	8.2	1.8
<i>Willamette River:</i>						
Portland, Oregon.....		1	7.5	27	2.6	4.9
<i>Colorado River:</i>						
Yuma, Arizona.....		27	16.8	14	16.1	0.7

FLOODS.

Yuma, Arizona: on the 1st light rain fell during the greater part of the day. The wind which at 7 a. m. was blowing gently from the south backed to the southeast and increased in force until at 12.15 p. m. it attained a velocity of thirty-four miles per hour. Seventy-five miles west of Yuma the rain was heavy, causing a washout on the Southern Pacific Railroad and delaying trains. On the 15th a thunder-storm began at 10.55 a. m. and continued until 4.30 p. m. During this storm 1.57 inches of rain fell, 0.80 inch falling in twenty minutes, from 2.40 to 3 p. m.; this is the largest rainfall that has occurred since the Signal Service station was established here (1876). The track of the Southern Pacific Railroad was washed out both east and west of Yuma, causing an entire suspension of traffic for several days. On the 27th heavy rain fell in the mountains east of Yuma, producing floods and destructive washouts which delayed trains.

Colorado Springs, Colorado: at 3 p. m. of the 1st very dark and threatening clouds were noticed hanging over the country north of the town, some of these were similar to tornado clouds, being funnel-shaped. Shortly after 3 p. m. very heavy rains set in and being confined within the narrow valley of Monument Creek caused a sudden and destructive freshet. At 6 p. m. the flood suddenly poured into the town, carrying away fences, bridges, and several buildings. Along Monument Creek and Shook's Run thousands of dollars worth of property in bridges and roads were destroyed. The storm was accompanied by unusually heavy hail; above the town on the following day hail still covered the ground to a depth of four inches on an average, in some places it had drifted four feet deep. Large patches of hail from one to three feet deep were deposited along the track of the flood. Trees were denuded of leaves and small branches as well as considerable bark.

Little Rock, Arkansas: during the afternoon and night of the 1st a severe thunder-storm prevailed, beginning at 4.40 p. m., with moderately heavy rain until 8.50 p. m.; at this time very heavy rain set in, and in one hour and ten minutes 2.60 inches had fallen. In consequence of this unusually large rainfall the streets were flooded and property was damaged to the extent of \$25,000. Many stores on Main street were filled with water to the depth of eighteen inches.

HIGH TIDES.

Smithville, North Carolina, 26th, 27th, 28th; Cedar Keys, Florida, 18th.

ATMOSPHERIC ELECTRICITY.

AURORAS.

Mount Washington, New Hampshire: at 8.08 p. m. of the 23d an auroral light was observed in the northwest and north. Stratus clouds were banked in the north, obscuring the arch; from behind the clouds bright streamers rose to an altitude of 80°, converging near the zenith. At 8.15 p. m. a bright band of light, elliptical in form, extended across the sky. This band moved slowly across the zenith at 8.32 p. m., after which it began to fade, and disappeared at 9.10 p. m. The aurora proper rapidly increased in brilliancy and extent, at 9.10 p. m. extending from west-northwest to east 10° north. The streamers were unusually narrow but clearly defined and very brilliant. At the time of maximum brilliancy, 9.10 p. m., a lateral motion from west to east was seen. The aurora disappeared at 1.30 a. m. of the 24th.

Washington City: a fine aurora was visible during the evening of the 23d. The first light noted was at 8.15 p. m., and consisted of a patch of greenish light in the north-northeast, near the horizon. This light seemed to spread east and west, in a few minutes the horizon, 30° either side of north, was illuminated by the light. The highest point above the horizon was not more than 15°. At 8.22 p. m. there was a sudden brightening, the light forming an arch, and was accompanied by streamers, which, in some instances, reached an altitude of 45°. This appearance gradually died away, to be succeeded at 8.26 by the same. The moments of brightening and display

of streamers were 8.32, 8.40, and 8.43 p. m. At 8.48 the appearance was quite faint, and at 8.53 p. m. all had vanished except a hazy spot in the north-northwest. At 9.03 the arch of light again appeared fully as bright as before, but there were no streamers up to 9.20 p. m., when the observer ceased to watch the display. The most important point to be noted is the fact that the streamers started from below the arch; not only were they seen to start below the arch but their path across it was distinctly seen. This would seem to indicate that they were independent of the arch. The streamers seemed to converge to a point beneath the horizon.

Beverly, Burlington county, New Jersey: an aurora was visible from 7.30 to 9 p. m. of the 23d. It first appeared as a pink glow, afterwards as a low white arch. At 8.40 p. m. three narrow white streamers appeared. The arch disappeared at 8.50 p. m., leaving only a white glow in the northeast.

New York City: an aurora was seen at 8 p. m. of the 23d, illuminating the northern horizon. The light appeared in the shape of a well-defined arch, covering about 100° of azimuth. At times the light became quite brilliant, with streamers shooting upward and outward, giving the display the appearance of a blazing fan.

Bancroft, Kossuth county, Iowa: an auroral display commenced at 8.10 p. m. of the 23d and continued, with varying degrees of brightness, until 11 p. m. It consisted of a bright arch, with rapidly changing streamers darting from the upper surface.

Gardiner, Kennebec county, Maine: brilliant auroral streamers were seen flashing from above a dark cloud at 9 p. m. of the 23d. At 10 p. m. the streamers had coalesced and the display resembled moonlight.

Winnemucca, Nevada: a faint aurora was visible for about two hours during the evening of the 23d. It was first seen about 8 p. m. and disappeared at about 10 p. m. The light faded away so gradually that it was scarcely possible to note the exact minute of its disappearance. The display was brightest at a few minutes after 9 p. m., though at no time was it very brilliant. Its first appearance was in the form of a yellow glow in the northern horizon, which became more distinct as the twilight faded and the sky became darker. It then presented the appearance of an irregular arch of yellow light. At times a greenish tint could be observed near the upper edge of the arch. The azimuth of the western extremity was 155° and of the eastern 215°; altitude, 15°. The degree of brilliancy varied at times, but there were no flashes of light, nor any motion of the arch, except that in disappearing the size of the arch diminished, seeming to sink down and finally disappear below the horizon.

Duluth, Minnesota: an aurora was observed from 9.30 p. m. of the 23d until daylight of the 24th. The aurora as first seen consisted of pale yellow light extending from azimuth 95° to 260°. At 10.30 p. m. it had gradually assumed the form of an arch, which extended from azimuth 110° to 255°, with an altitude of 30°. Streamers appeared at 10.45 p. m., and continued to increase in size and number until 11.15, when the display was quite brilliant.

Fort Buford, Dakota: a fine auroral display commenced at 10.25 p. m. of the 23d. It first appeared as two brilliant white arches of light extending from northwest to east. The height of the upper arch was about 25°. The lower arch was bounded beneath by a very dark segment through which the stars were dimly seen. At 11 p. m. a third, and part of a fourth arch were formed, the fourth extending nearly to the zenith. At this time the eastern extremities of the arches began to break into yellow streamers which shot up like flames to a height of 30°. At 11.30 p. m. the western sides of the arches were perfect, while the eastern ends assumed the form of a large white curtain swayed by the wind. The display faded from view shortly before midnight.

La Crosse, Wisconsin: a red auroral light was noticed at 9.20 p. m. of the 23d in the northern sky. At 9.45 p. m. a pale white arch had formed. Shortly after 11 p. m. a second

arch was seen, at an altitude of 50°, slowly advancing toward the zenith. The aurora disappeared at 11.47 p. m.

Auroral displays were also observed during the month, as follows:

- 2d.—Embarras, Wisconsin.
- 4th.—Vevay, Indiana; Parkersburg, West Virginia.
- 5th.—Vevay, Indiana.
- 7th.—Webster, Dakota; Poplar River, Montana.
- 11th.—Fort Totten, Dakota; Heath, Massachusetts; Egg Harbor City, New Jersey.
- 12th.—Eastport, Maine; Palermo, New York.
- 13th.—Fort Totten, Dakota; Mackinaw City, Michigan; Duluth, Minnesota.
- 14th.—Eastport, Maine; Mackinaw City, Michigan.
- 16th.—Westborough, Massachusetts.
- 17th.—Fort Totten, Dakota; Mackinaw City, Michigan; Newport, Vermont.
- 20th.—Orono, Maine; Berlin Mills, New Hampshire; Newport, Vermont.
- 21st.—Lunenburg, Vermont.
- 22d.—Block Island, Rhode Island.
- 23d.—New Haven, New London, Hartford, North Colebrook, and Southington, Connecticut; Webster and Fort Totten, Dakota; Riley, Illinois; Fort Madison, Independence, Manchester, and Monticello, Iowa; Allison, Kansas; Eastport, Portland, Bar Harbor, and Orono, Maine; Woodstock, Maryland; Blue Hill Observatory, Cambridge, Boston, Fall River, Milton, Princeton, Somerset, and Westborough, Massachusetts; Grand Haven, Mackinaw City, and Traverse City, Michigan; Moorhead, Minnesota; Poplar River, Montana; Valentine, Nebraska; Nashua, New Hampshire; Beverly, Clayton, Dover, Moorestown, and Upper Mountclair, New Jersey; Albany, Cooperstown, Factoryville, Mountainville, and Setauket, New York; Bethlehem, Catawissa, Dyberry, and Wellsborough, Pennsylvania; Variety Mills, Virginia; Fort Spokane, Washington Territory; Manitowoc and Prairie du Chien, Wisconsin.
- 24th.—New London, Connecticut; Lunenburg and Post Mills, Vermont.
- 25th.—Pekin, Illinois.
- 26th.—Pekin, Illinois; Atlantic City, New Jersey; Newport, Vermont.
- 27th.—Windsor, Illinois.

THUNDER-STORMS OF AUGUST, 1886.

[By Jr. Prof. H. A. HAZEN.]

During August there were received from voluntary observers 631 reports of distinct storms; from Signal Service observers 337; and from special thunder-storm observers 1,884, making a total of 2,852, or 470 more than during June, and 144 more than during July. The distribution by states and districts will be seen in the accompanying table. This table does not give an idea of the relative frequency in the different states, as some have many more observers than others, but it will serve for comparison with similar tables in previous months. The days of greatest number were 1st, 219; 11th, 203; 12th, 238; 13th, 273; and 16th, 298; and of least number, were 2d, 19; 3d, 12; 7th, 14; 19th, 17; 20th, 18; 24th, 6; 25th, 17; 26th, 13; and 31st, 18. It will be seen that there were two well-marked periods of thunder-storm activity, from the 11th to 17th, and from the 27th to 30th. On the 16th the conditions were specially interesting, it being the hottest day of the month, the temperature rising to 104° in the afternoon. On this date there were the most storms of any day, and some idea of the conditions on this date may be gleaned from chart ix. Most all the storms on this date occurred before noon, hence the map of isobars, isotherms, and wind-directions has been chosen for 7h.00. It will be seen that, as in the previous month, nearly every storm is in the southeast quadrant of the low area. This chart is specially interesting as showing the conditions ushering in the tornadoes of the afternoon of this date, elsewhere described in detail.